DOCUMENT RESUME

ED 154 753 HE 010 084

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TITLE Labor Market Incentives, Intellectual Competence and College Attendance. Revised.
INSTITUTION University and Coll. Theater Association, Washington, D.C.
SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.; Office of Education (DHEW), Washington, D.C. Office of Planning, Budgeting, and Evaluation.
PUB DATE Mar 78
CONTRACT 300-75-0382
GRANT NIE-G-76-0076
NOTE 35p.

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS *Academic Ability; *College Bound Students; Educational Economics; *Employment Opportunities; Females; Higher Education; *High School Graduates; Human Capital; *Job Market; *Labor Market; Males; Socioeconomic Status; Womens Education
IDENTIFIERS *Education and Work

ABSTRACT

Presented are the preliminary results of a study of the effects of relative labor market opportunities for the highly educated on high school academic achievement and college attendance. Across regions, a one percent decline in college relative to high school graduates is estimated to induce a decline of 0.3 to 1.4 percent in reading and mathematics test scores of white females. The effects on males are somewhat smaller. Regional labor market effects on college attendance probabilities are found to be even stronger. The effects of family structure and socioeconomic status on academic performance and college attendance are also examined within the context of a general model of human capital formation. (Author/MSE)

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LABOR MARKET INCENTIVES, INTELLECTUAL COMPETENCE AND COLLEGE ATTENDANCE

By

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March 15, 1978

(Revised)

Preparation of this paper has been supported by the Office of Planning, Budgeting and Evaluation, U. S. Office of Education (Contract No. 300-75-0382), and by the National Institute of Education (Grant No. NIE-G-76-0076). Continuing econometric advice has been provided by Jon K. Peck. The labor market files were constructed under the direction of Eric A. Hanushek. The authors would acknowledge the contributions, interest and support of John Haines, of OPBE, and Ivan Charner, of NIE. Candace Cole, Ruth Schultz, Lynn Miehle, Daniel Updegrove and Donald Showalter have contributed significantly to the progress of the study at various stages.

An earlier version of this paper was presented to the Annual Meeting of the American Association for the Advancement of Science in Washington, D. C., on February 16, 1978.

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4/13/78

Abstract

This paper presents the preliminary results of a study of the effects of relative labor market opportunities confronting the highly educated on high school academic achievement and college attendance. Across regions, a one percent decline in the lifetime earnings of college relative to high school graduates is estimated to induce a decline of between 0.3 and 1.4 percent in reading and mathematics test scores of white females. The effects for males are somewhat smaller, with test scores declining by between 0.2 and 0.6 percent.

Regional labor market effects on college attendance probabilities are found to be even stronger. A $7500 decline in the lifetime earnings of college educated women, holding the earnings of high school educated women constant, would imply a decline in the probability of female college attendance from a hypothetical 20 percent to between 4 and 8 percent, from a hypothetical 50 percent to between 15 and 27 percent, or from a hypothetical 80 percent to between 40 and 60 percent. Again, effects for males, while still substantial, are of significantly lesser magnitude. For example, a comparable decline in lifetime earnings of male college graduates would reduce a hypothetical male's probability of attending college from 50 percent to between 37 and 43 percnet.

The effects of family structure and socioeconomic status on academic performance and college attendance are also examined within the context of a general model of human capital formation.

LABOR MARKET INCENTIVES, INTELLECTUAL COMPETENCE AND COLLEGE ATTENDANCE

An unfortunate consequence of the continuing and often acrimonious debate concerning the relative importance of genetic versus environmental determinants of "ability" is that two very significant issues have been largely ignored. First, what are the social and economic implications of the indisputably unequal distribution of ability, however defined and whatever the source of inequality? Second, given innate ability, however defined, what factors influence levels of effective intellectual performance?

A recent theoretic model developed by Dresch (1978) addressed one facet of the first of these questions, demonstrating that, if efficiency in schooling depends upon ability and if the returns to schooling are greater for the highly able (i.e., ability and human capital are complementary in production), then the ability distribution of the population constitutes the primary determinant of the supply of highly educated labor. Furthermore, empirical evidence increasingly suggests that, because of this dependence of the supply of highly educated labor on ability, the supply function may quickly become very inelastic; if so, then the unequal distribution of ability imposes a severe constraint on continuing increases in educational attainments, even in the absence of declines in rates of return to college-level schooling. However, that model did not consider the even more serious possibility that effective ability itself might deteriorate in response to declining rates of return to education.

Investigations by social scientists into the determinants of effective intellectual performance, or competence, have been severely restricted in purview. The predominant focus has been on the effects of schooling and family inputs (school expenditures, teacher qualifications, the quality and quantity of parental time) on academic performance (Coleman, 1966; Hanushek, 1972; Leibowitz, 1974; Dugan, 1976; Murnane, 1975). The notion of a demand for competence, when it has been considered at all, has been reduced to consumer "tastes" or to a noneconomic, sociopsychological concept of "motivation." The concept of motivation or of the demand for competence as a function of anticipated economic rewards is surprisingly absent in this literature, although it represents a logical extension of lifecycle models of human capital formation (Ben-Porath, 1970).

The first section of this paper develops a theoretical model of the determinants of intellectual competence, in which attained competence is portrayed as the consequence of individual welfare maximization subject to constraints. Central to the model is the concept of labor market rewards to competence. However, for purposes of this model, the underlying source of these rewards is a matter of indifference. Thus, the model is consistent either with a neoclassical view of competence as an input into production, enhancing the marginal productivity of labor, or with a queueing, screening or certification view in which competence serves only to enhance the individual's access to labor market rewards without enhancing his productivity (Spence, 1973; Arrow, 1973; Stiglitz, 1975; Thurow, 1974).

In the theoretical model intellectual achievement in high

school and the decision to attend or forego college are represented as jointly dependent variables. A reduced form of this model is then empirically tested, using panel data on two cohorts of recent high school students. The data are briefly described in the second section of the paper. The third and fourth sections, respectively, develop the models in greater detail and present the intellectual achievement and college attendance estimates. Finally, the fifth section speculates on the possible implications of the results for the interpretation of such phenomena as recent declines in academic achievement over time and the persistently lower academic performance of nonwhites. Even at this very preliminary stage, the results clearly indicate the critical importance of addressing these admittedly sensitive issues in a structured and comprehensive manner if the determinants of observed behavior are to be meaningfully comprehended.

1. The Basic Model

The conceptual schema underlying both the theoretical and empirical models discussed here derives from contemporary human capital theory. Essentially, the individual is viewed as confronting a spectrum of alternative paths (school versus work, alternative occupations, etc.) and selecting that path which maximizes the present value of his expected lifetime utility or welfare, recognizing the risks and uncertainties associated with each path. Most importantly, options are recognized to be temporally interdependent, i.e., one choice rather than another today forecloses some future options while maintaining the feasibility of other future options; conversely, the payoff to a future activity may motivate current behavior necessary to make feasible that future activity.

The focus of the present analysis is on the effects of perceived labor market opportunities on intellectual competence and schooling decisions, specifically on high school academic performance and the decision to attend college. Factors other than expected pecuniary returns, e.g., present or future consumption benefits, productivity in household production, and risk and uncertainty consequences, undoubtedly influence educational behavior, achievement and aspirations. However, it is assumed provisionally that a high school student's perceptions of the benefits of college respond primarily to the observed, more-or-less localized differential between the lifetime earnings (appropriately discounted) of college and of high school graduates in the labor force. Furthermore, if academic or intellectual achievement is perceived to be of greater relative benefit to those who intend eventually to become highly educated, then an individual's incentive to improve his academic performance will also depend upon the perceived returns to a college education. If the returns to college are perceived to be sufficiently low, then an individual will plan not to attend college and will reduce the effort which he devotes to the improvement of his intellectual competence, perhaps devoting greater effort to the development of nonacademic vocational skills or competencies.

Somewhat more formally, attained intellectual competence of a high school student, denoted I, can be viewed as generating a stream of gross returns, the present value of which is V_U in the less educated sector of the labor market and V_E in the more educated sector, i.e.,

(1a) $$V_U = f_U(I)$$

and

(1b) $$V_E = f_E(I)$$

It is assumed that the marginal return to competence is positive ($dV_i/dI>0$) but declining ($d^2V_i/dI^2<0$).

Moreover, it is hypothesized that $dV_E/dI>dV_U/dI$ for all values of I, i.e., the marginal return to an increment in competence is always higher in the educated sector of the labor market.

The production of competence, of course entails costs: Purchased inputs and personal (family) time and effort are required. Also, because of genetic differences, the efficiency with which individuals can produce competence may vary significantly. And, finally, competence and the efficiency with which it can be augmented may well depend upon family structure and socioeconomic characteristics, reflecting, e.g., the quantity and quality of prior parental investments in child quality. Thus, the production function for competence may be represented as

(2) $$I = g(X;G,S)$$

where X represents scarce variable inputs,

G represents genetic endowments, and

S represents prior family inputs, e.g., family structure and socioeconomic characteristics, as these affect efficiency in the production of competence.

This function is assumed to exhibit declining marginal productivity of inputs λ, i.e., $\partial I/\partial X>0$ but $\partial^2 I/\partial X^2<0$.

If, then, the individual faces prices P on the inputs X (in-

cluding prices on his own time and effort and on those current inputs of parents), then the net return to an enhancement of competence in either labor market sector, denoted V_{iN} (i=E,U), is

$$V_{iN} = V_i - PX \tag{3}$$

The first-order condition for maximization of net returns to competence in either sector of the labor market is, then,

$$\frac{\partial V_{iN}}{\partial X} = 0 = \frac{dV_i}{dI}\frac{\partial I}{\partial X} - P \tag{4a}$$

or

$$\frac{dV_i}{dI}\frac{\partial I}{\partial X} = P \tag{4b}$$

It can be easily demonstrated that the second-order condition for a maximum is also fulfilled.

Assuming competitive, nondiscriminatory labor markets, dV_i/dI will be equal for everyone. However, $\partial I/\partial X$ and P will vary across individuals. Thus,

$$\frac{\partial^2 I}{\partial G \partial X} > 0, \tag{5}$$

i.e., the more favorable one's genetic endowment the greater the increment in competence which can be anticipated to flow from the marginal application of resources of type X. Also,

$$\frac{\partial^2 I}{\partial S \partial X} > 0, \tag{6}$$

i.e., a more favorable socioeconomic background (greater or higher quality parental investment of time and purchased inputs into child quality, etc.) will increase one's current and future efficiency in the production of competence.

Variations in prices of variable inputs X introduce greater

complexities. For example, the price (opportunity cost) of one's own and one's parents time will vary with the market wages which can be commanded. Similarly, capital market imperfections will result in higher effective prices on purchased inputs for the less wealthy, even if the markets for these inputs are themselves competitive and nondiscriminatory.

Denoting by I_i^* that level of competence which generates the maximum net return to competence in either labor market sector, given G, S and P, the most important implication of the foregoing model is that $I_E^* > I_U^*$, i.e., a decision to enter the highly educated labor market will lead an individual to invest in a higher level of intellectual competence, since $dV_E/dI > dV_U/dI$. Also, of course, I_i^* will be associated positively with a more favorable genetic endowment or socioeconomic background and negatively with higher prices on current inputs.

If V_{iN}^* is the maximum net return which can be derived in sector i of the labor market, then the decision to enter the highly educated labor market can be seen to depend upon the relative net earnings gain associated with education, π_E, defined as

$$\pi_E = (\overline{W}_E + V_{EN}^*)/(\overline{W}_U + V_{UN}^*) \tag{7}$$

where $\overline{W}_E$ and $\overline{W}_U$ are the earnings which would be commanded by a person possessing a standardized unit of intellectual competence in the educated and the uneducated labor markets, respectively.

In a simple world of perfect certainty, the individual would choose to become highly educated if and only if π_E were greater than unity. In a more realistic context, the probability that an individual

will choose to become educated will depend upon the value of π_E predicted for that individual. Correspondingly, the higher the predicted value of π_E, the greater the intellectual competence which that individual would be predicted to acquire.

Thus, both the probability, p_E, of choosing to pursue the highly educated option and also the level of measured intellectual competence can be viewed as functions of $\overline{W}_E$, $\overline{W}_U$ and the various variables entering into the determination of optimal competence in either sector of the labor market. The reduced form of the model is, simply,

$$p_E = h(\overline{W}_E, \overline{W}_U, G, S, P), \tag{8}$$

and

$$I = k(\overline{W}_E, \overline{W}_U, G, S, P), \tag{9}$$

with the properties that each will vary positively with $\overline{W}_E$, G, and S, and negatively with $\overline{W}_U$ and P.

An important implication of this model is that an empirical estimation of the probability of choosing to become highly educated as a function of measured intellectual competence will produce possibly seriously biased estimates of the other parameters of the model. This will be especially true of the family structure/socioeconomic variables, which to some degree will also incorporate the generally unobserved effects of individual genetic endowments, since the genetic constitution of parents will contribute both to the genetic constitution of offspring and to socioeconomic status. However, downward biased coefficients would be expected for all variables entering the intellectual competence equation, specifically including the earnings variables $\overline{W}_E$ and $\overline{W}_U$.

This conclusion is important because of the treatment of measured achievement or ability in previous studies of college attendance. Whether these studies have included ability as an explanatory variable (e.g., Kohn, Manski and Mundel, 1976) or have stratified on ability (e.g., Bishop, 1977) in estimating college attendance models, ability has invariably been found to be one of the most important determinants of college attendance. However, if it is in fact a jointly determined variable, then this finding is hardly surprising. The most serious consequence of the failure to recognize the joint dependence of ability is that biased effects of other, exogenous variables may result from the implied misspecification.

2. Empirical Implementation

The reduced form of this model, equations 8 and 9, has been estimated utilizing panel data on national samples of two cohorts of high school students, (1) the National Center for Education Statistics (NCES) National Longitudinal Study of the High School Class of 1972 (NLS), and (2) an American College Testing Program (ACT) norming sample of 1973 high school juniors. The ACT sample, most of whom (94 percent) graduated from high school in 1974, were resurveyed in the Spring of 1976 by the Institute for Demographic and Economic Studies (IDES) and are identified here as the IDES (1974) sample. Both samples were designed to be representative of their respective cohorts of high school students, without regard to future college attendance plans; only persons who left high school before the time of the base year surveys (the spring of the

junior or senior year) are excluded from the sample design.

Base year data collection in each case involved the administration of a battery of achievement tests to all members of the sample. For present purposes, intellectual competence, I, is measured by reported scores on the reading and math tests included in the respective batteries. To facilitate comparison across the two cohorts, scaled scores (mean 50 and standard deviation 10) are employed.

In both cases a follow-up survey was conducted in the second academic year after high school, the NLS in October 1973 and the IDES/ACT in March 1976. Entry into a four-year college at any time before the follow-up survey is utilized as the measure of an individual's intention to enter the highly educated labor market.

Of the exogenous variables entering equations 8 and 9 (probability of attending college and effective competence equations), both data bases provide extensive self-reported information on S, family structure and socioeconomic characteristics. For present purposes, the following specific variables were employed: parents' income, father's and mother's years of schooling, and numbers of younger and older siblings. Parents' income is also the only measure of possible differences in prices of inputs into competence included in the equations.

Not surprisingly, no measures of individual genetic endowment, G, are available. Except for an unidentifiable systemmatic component associated with family background variables, genetic endowments are assumed to be distributed randomly and to be uncorrelated

with other explanatory variables in the model.

Exogenous variables describing the relative labor market conditions confronting a high school student cannot be obtained from these data files. Ideally, one would ascertain individual perceptions of expected earnings over time as a high school graduate and as a college graduate. The relationship between these perceptions and conditions actually prevailing in a local or regional economy could then be assessed explicitly. In the absence of this type of information (available for the IDES sample but only for persons intending to complete college) it is necessary to utilize objective estimates of lifetime earnings of college and high school graduates in local or regional economies.

In principle, individual perceptions of relative labor market opportunities might respond to national or even international market conditions. In this case, the present model could be estimated only by utilizing pooled cross-section/time series data on samples of a large number of successive cohorts, data which are simply unavailable. Therefore, it is necessary to entertain the not unreasonable hypothesis that individual perceptions of earnings opportunities are shaped by the regional or local labor market. Thus, the analysis examines the effects of geographic variations in relative opportunities in the highly educated and less educated labor markets on individual achievement and college attendance.

A priori, the size of the relevant labor market on which individual perceptions depend is not obvious. Perceptions might be more or less localized. For this reason, a basic labor market data file, derived from the 1970 Census Public Use Sample (a one

percent sample of the U. S. population), was constructed on a relatively small-area basis, utilizing 341 Standard Metropolitan Statistical Areas and 5-digit county groups (economic groupings of counties, with populations of at least 250,000). For each of these areas cross-section samples of full-time, full-year workers over age 16 were used to estimate lifetime earnings functions of the form

$$(10) \qquad \ln y = b_0+b_1 s+b_2(a-s-6)+b_3(a-s-6)^2$$

where y is earnings,

s is years of schooling completed, and

a is age.

The term (a-s-6) in these equations represents a proxy for years of labor force experience. These earnings functions were estimated separately for persons with 12 or fewer years of schooling and for persons with more than 12 years of schooling, stratifying by race and sex.

The predicted present values of earnings of college and high school graduates for each race/sex group in an area were then computed by integrating these earnings functions between the ages of 18 and 64 for high school graduates (s=12) and between the ages of 22 and 64 for college graduates (s=16), discounting to age 18 at a rate of five percent. Because of the expense involved in dealing with a file of the size of the Public Use Sample, predicted present values for higher geographic aggregations were computed as the weighted means of relevant SMSA or five-digit county group values.

Three levels of geographic aggregation were tested in the behavioral equations: (1) the 341 SMSAs or five-digit county

groups, (2) 147 three-digit county groups, (3) nine Census divisions. Weak but erratic labor market effects were observed at the lower levels of aggregation, in part perhaps because of small sample sizes and high measurement error. Also, these geographic groupings may simply be too small to serve as determinants of individual perceptions of relative opportunities. Any individual could easily escape a weak local labor market (educated or uneducated) simply by migrating a short distance, and individuals may well be aware of this option. Thus, the possible substantive inadequacy of the small-area basis, compounded by the small sample sizes and high standard errors encountered in the estimation of the earnings functions, led eventually to the utilization of earnings variables W_E and W_U estimated for Census divisions, as presented in Table 1.

In addition to the predicted present values of lifetime earnings of college and high school graduates, a measure of the aggregate employment rate in the local area (SMSA or five-digit county group) is included to capture the effects of the general condition of the immediately local economy. To avoid the possibility that the present values of college and high school earnings are capturing effects of other characteristics of a region (Census division), the regional net migration rate and farm proportion of the population are included. To permit lagged, inertial responses to changing labor market conditions, the 1970 regional proportion of the 18 to 24 year-old population in college is included in the equations. Finally, regional median family income is included in the intellectual competence equations to capture general regional affluence effects (e.g., tastes, higher schooling

expenditure).

The estimations of the model presented here are based on subsets of only the white members of the respective samples.

3. Explaining Intellectual Competence

To achieve at least rough compatibility between the NLS and ACT reading and math test equations, in addition to normalizing to a common mean and standard deviation the dependent variables are expressed as the natural logarithms of the various test scores. As a result, the coefficients represent proportional changes in scores with respect to unit changes in the exogenous variables. Because preliminary statistical evidence (F tests) indicated that persons from low income families respond very differently than persons from high income families to changes in some exogenous variables, for these variables separate depooled coefficients have been estimated for each income group. In the NLS (1972) equations low income persons are defined as those with family incomes less than $7500. In IDES (1974) equations low income is defined as less than $9000. The estimated equations are presented in Table 2.

The exogenous variables in a model of the production of intellectual competence fall primarily into two groups: (1) those variables which reflect the quantity and quality of family inputs during childhood, and (2) those variables which reflect the labor market returns to investments in academic achievement.

Variables included in the first category are parents' educational levels, numbers of siblings and birth order, and parents' income. Psychologists often have found that larger family size adversely affects test performance, and economists have reasoned

that this is due, at least in part, to the spreading of family investments in child quality over a larger group (Leibowitz, 1974). Further, children lower in birth order receive proportionately more time, with the first child born receiving the entire amount of parents' time and purchased inputs into child quality until the second child is born. With a test of this theory in mind, variables for being first born, but not an only child, for being an only child, and for numbers of older and younger siblings were included in the equations. However, as pointed out by Stafford (1974), a more complete model would recognize the endogeneity of family size in parental decisions concerning inputs into child quality.

The coefficients of the first-born and only-child dummy variables would both be expected to be positive under the parental investment hypothesis, while negative coefficients would be expected for the older and younger siblings variables, with an older sibling having a larger effect than a younger sibling. Although the possible substitutability of sibling for parental input might introduce some ambiguity into these effects, the empirical results strongly support the economic interpretation of the family structure variables. Only the only-child variable, with a highly significant negative coefficient, does not perform as expected. The adverse effect of being an only-child, which is consistent with the findings of psychological studies, may indeed be the result of a violation of the ceteris paribus assumption that fewer children imply greater parental input per child, if, e.g., the probability that the mother will work is higher in single-child families.

Parents' educational attainments and family income would also

be expected to imply greater parental input into child competence. Greater parental education would imply higher quality inputs and might also constitute a proxy for the genetic endowment of the child. Because children have been observed to spend significantly more time with their mothers than with their fathers, at least historically, it would be expected that the coefficient of mother's education would be relatively greater than that of father's education. Although exhibiting the correct signs, the results, however, do not conform closely to these expectations. In the case of low income persons, mother's and father's education have no consistantly significant effects. For high income females in the NLS sample, in both the reading and math score equations the coefficients on the two parental education variables are equal, as are their standard errors. For NLS males father's education, contrary to a priori expectations is more significant and had a larger positive impact. For the IDES sample, the pattern of signs suggests that, relative to father's education, mother's education had a greater impact on reading scores and a smaller impact on math scores.

Parents' income would be expected to have a positive impact on test scores because it will affect the quantity and quality of inputs into the production of child competence which can be purchased, especially if capital markets are imperfect. The empirical results indicate a weak (not significant at the one percent level) influence of income on academic achievement measures, except in the case of the math scores for NLS males. However, even in that equation the estimated elasticity is only 0.03. The absence of strong income effects may reflect the fact that the income measure pertains only

to income reported in one given year, rather than to either permanent income or income throughout the childhood of the individual. Also, the income measure is likely to suffer from the reporting error that often accompanies a child's report of family income. Aside from measurement error, the insignificance of the income variable may reflect parents' willingness and ability to borrow to purchase inputs and/or to substitute own time for these inputs. The analysis is complicated by the fact that incomes may be higher for those respondents who had two working parents and these respondents may have received lower parental time input as a result of the parents' labor force participation decisions. This could lead to a negative relationship between income and achievement for these respondents, while results based on respondents with one working parent might indicate a positive income-achievement relationship. With data on working parents this hypothesis could be tested.

As indicated in the first section of this paper, the novel feature of this analysis is the inclusion of labor market variables reflecting the returns to education. Exceeding all other variables in mangitude and exceeded in significance only by the parents' education, only-child and older-siblings variables, the present value of lifetime earnings of the college relative to the high school educated consistently exerts a substantial influence on academic performance. A one percent increase in relative earnings of college graduates induces an 0.2 to 1.4 percent increase in scores. Most notably, the effects for women (especially higher income women) generally greatly exceed those for men. Also, the effects are greater for members of the 1974 cohort than for

members of the 1972 cohort, suggesting the possibility of a temporal increase in labor market responsiveness (a phenomenon, clearly, which cannot be demonstrated with data for only two cohorts utilizing the same relative earnings measures in each region).

The form of this labor market return to education in the model is the log of the ratio of college to high school lifetime earnings (equal to the difference of the logs). Thus, the hypothesis being tested is whether or not relative earnings influence academic performance. If the coefficients on each of the log earnings components were not constrained to be equal in magnitude and opposite in sign, it might be hypothesized that the results reflect a correlation between, e.g., schooling expenditures and regional earnings in general. This is clearly not the case in the current specification, especially since regional median family income is included in the equation to capture these schooling-expenditure and taste-for-schooling effects associated with income levels.

The remaining regional variables do not show strong consistent influences across the two samples. The proportion of 18-24 year olds in college is more significant for the IDES sample, and the positive sign is that which would be expected if schooling behavior responds inertially to labor market incentives. The negative coefficient on the net migration variable, significant in the IDES math test equations, may be explained by the effects of rapid population growth on the quality of schooling. Contrary to expectations, the log of the employment rate in the local area, a measure of the probability of being able to obtain employment after high school and therefore a reflection of foregone earnings, does not exert a

significant negative influence on academic performance. One possible explanation is that this variable very imperfectly measures the probability of "new" hiring of recent high school graduates.

4. College Attendance Decisions

Unlike the intellectual competence model, in which the dependent variable is continuous (the log of a test score), the college attendance model involves a dichotomous dependent variable (equal to one if the individual ever attends a four year college, equal to zero otherwise). In a model of this type ordinary least squares (OLS) estimates of a linear probability model (LPM) will produce inconsistent estimates if a logistic or probit model is theoretically appropriate. The linear model can indeed be argued to be inappropriate because (1) the LPM produces implausible results near the boundaries of zero and one and may well produce estimates which lie outside these boundaries, and (2) there is reason to believe that the effect on the probability of a given change in an exogenous variable will differ depending on the values of the other exogenous variables, and hence on the ex ante probability. Thus, for example, a given change in income would be expected to have a greater impact on the decision to attend college if the probability of attendance in the absence of the change in income were 0.5 than if the ex ante probability were 0.1 or 0.9; and if the effects were constrained to be equal, as in the LPM, a probability lying outside the zero-one range could easily be predicted. Logit and probit models are superior in that they do incorporate generalized interactions between the various exogenous variables and produce bounded estimates of the predicted probability.

Table A presents the final maximum-likelihood coefficient estimates of a logistic college attendance model, in which the dependent variable is the log-odds of attendance, $\ln[p/(1-p)]$. Because the logit coefficients themselves are not intuitively interpretable, Table 3 presents elasticities at the mean of the probabilitiy of attending a four-year college with respect to each of the exogenous variables. In addition to the reduced-form model, excluding achievement test scores, the model has also been estimated including the test scores as explanatory variables, providing an indication of the magnitude of the biases introduced by treatment of the jointly dependent test scores as exogenous variables in the college attendance model. Discussion is initially focussed on the theoretically appropriate reduced-form equations.

To indicate the substantive implications of the logit formulation, as contrasted to LPM, Table 4 presents the ex post probability of attending college when each of the indicated explanatory variables, in isolation, is changed by a specified amount (in general, ± one standard deviation), for each of three ex ante probabilities (0.2, 0.5, 0.8). In this table, the sensitivity of the change in the probability of attendance to the initial probability is clearly revealed. The estimates in each case are based upon the reduced form equations in Table A (excluding test scores).

The college attendance model builds upon the intellectual competence model and includes many of the same variables. The coefficients of the parents' education variables have signs, magnitudes and significance levels consistent with expectations and with the estimated competence model. A one standard deviation (approximately

three year) reduction in father's education would reduce the probability of attendance from, e.g., 0.5 to between 0.38 and 0.43. A comparable one standard deviation (2.3 year) reduction in mother's education would generally have somewhat smaller effects.

In contrast to its relative insignificance in the test score equations, parents' income enters significantly in all attendance equations, with an elasticity at the mean of approximately 0.3. Since socioeconomic effects related to income would be expected to appear in the test score equations as well, one explanation for the discrepancy would be provided by cpaital market failures which more severely constrain the options of lower income students.

The log of the number of children variable (replacing the previous set of four family structure variables) is negative, and in the case of males highly significantly so. In fact, in the male equations the coefficients on parents' income and the number of children variables (both in logs) are not significantly different (except for sign), suggesting that for males the relevant income measure is income per child.

The logs of average state tuitions for two year public, four year public, and four year private nonselective institutions enter the college attendance model. The signs on both four year college tuition variables were expected to be negative when the dependent variable was the probability of every attending a four year college. Higher tuition at public two year institutions was expected to increase the probability of attending a four year college. The four-year private and two-year public tuition varibles behave according to expectations, with four-year private elasticities of between -0.9 and -1.8. Four-year public

tuition, however, is significantly negative only in the case of the NLS (1972) males. Possible explanations include the unavoidable failure to incorporate either institutional quality or financial aid effects. Alternatively, the insignificance of this variable may reflect the non-price rationing of access to public four-year institutions, with private institutions representing the only effective option at the margin.

Again outweighing in relative magnitude all other exogenous variables in the model, the lifetime earnings variables exhibit extremely large elasticities. As in the competence equations the effects are significantly greater for females than for males and for the 1974 than for the 1972 cohorts. For a 1974 woman with an ex ante attendance probability of 0.8, a one standard deviation decline in the log of college lifetime earnings ($7500 at the mean of the log) would induce a decline in the probability of attendance to 0.4, or by 50 percent. A similar effect would be exerted by a corresponding increase in the present value of high school lifetime earnings. Although included separately, rather than in ratio form as in the intellectual competence equations, the coefficients of the college and high school lifetime earnings are generally not significantly different from each other in absolute magnitude, indicating that relative rather than absolute earnings constitute the primary influence on college attendance behavior.

Although, as expected, coefficients of virtaully all variables entering the theoretically appropriate attendance and competence equations are downward biased when test scores are included in the attendance equation, the magnitudes of the biases are not as

great as had been expected. Only the coefficients of mother's education in the female equations and father's education in the male equations are seriously reduced by the inclusion of test scores. Also the coefficients on the lifetime earnings variables for the NLS males and females and IDES females are somewhat reduced in magnitude when test scores are included. These observations, conjoined with the substantial increases in the predictive power of the attendance equations when test scores are included, suggest that the tests may in fact be quite sensitive to that component of genetic endowment not associated with family background variables.

It might be noted that the basic college attendance model presented here has also been estimated utilizing as dependent variables (1) the probability of attending either a four-year college or a two-year college with the intention of completing a four-year college degree, and (2) the intention, as of the junior (IDES) or senior (NLS) year of high school, of completing college. In both cases the results (available from the authors) are consistent with and quite similar to the estimates of the probability of attending a four-year college.

5. Speculations

Clearly, both the theoretical formulations and empirical estimates presented above must be considered preliminary, provisional and tentative. However, the results are suggestive of the possibly substantial impacts which labor markets may exert not only on schooling behavior but also on measured levels of achievement and competence.

Unfortunately, cross-sectional evidence for white members of two cohorts, using the same labor market data, cannot be employed to explain in any definitive terms such phenomena as, e.g., the causal influence of declining returns to college on declining college-admissions test scores and rates of college attendance over time, or the impact of historically lower returns to schooling for blacks on black academic achievement and college attendance. Also, a simplictic application of these results encounters such anomalies as the decline in test score performance of women while college going increased, although this is an anomaly which may be better explained by the much larger female proportions of successive cohorts actually taking the tests, implying rapid movement out of the upper tail of the female ability distribution.

In any event, the fact that the tentative results reported here invite such speculation indicates the importance of serious and sustained research into the two subjects identified at the beginning of this paper: the social and economic consequences of the unequal distribution of ability and the influences (especially labor market influences) on decisions concerning the development of intellectual competence.

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Table 1

Present Values of Lifetime Earnings
Whites By Region, Sex and Schooling

Region	Male			Female		
	College	HS	Col/HS	College	HS	Col/HS
New Eng	$190,664	$149,502	1.28	$109,430	$ 90,810	1.21
Mid Atlan	201,674	154,621	1.30	120,218	97,271	1.24
E N Cent	195,570	161,632	1.21	112,845	94,798	1.19
W N Cent	173,654	145,980	1.19	99,929	83,872	1.19
S Atlan	184,390	140,750	1.31	110,207	88,379	1.25
E S Cent	169,666	135,438	1.25	94,187	79,502	1.18
W S Cent	176,638	141,397	1.25	99,755	82,622	1.21
Mt	165,183	145,214	1.14	96,931	84,037	1.15
Pacific	190,543	163,551	1.17	114,386	100,780	1.14
National	187,519	151,296	1.24	109,756	91,292	1.20

Note: Lifetime earnings profiles estimated from 1970 Census Public Use Sample, cross-section of full-time full-year workers; present values for college and high school graduates (16 and 12 years of school, respectively) derived by discounting at 5 percent.

Table 2

ESTIMATED TEST SCORE REGRESSION EQUATIONS

	IDES (1974) Female		IDES (1974) Male		NLS (1972) Female		NLS (1972) Male	
	Reading (ln)	Math (ln)	Reading (ln)	Math (ln)	Reading (ln)	Math (ln)	Reading (ln)	Math (ln)
Parent's income (ln)	.014	.014	.029*	.002	.008	.014	.014	.031**
	(.012)	(.013)	(.013)	(.013)	(.010)	(.010)	(.009)	(.009)
Low Income (0,1)	-.094	-.040	.200	.186	.167	.200*	.025	.241**
	(.125)	(.132)	(.116)	(.114)	(.098)	(.097)	(.087)	(.084)
Father's Education (yrs)								
Low Income	.003	.002	.005	.006	.002	.002	.003	.000
	(.004)	(.005)	(.004)	(.004)	(.004)	(.004)	(.004)	(.004)
High Income	.006*	.006*	.008**	.012**	.007**	.007**	.005**	.007**
	(.002)	(.003)	(.002)	(.002)	(.002)	(.002)	(.002)	(.002)
Mother's Education (yrs)								
Low Income	.012*	.004	.000	.002	.002	.006	.000	-.008
	(.006)	(.006)	(.006)	(.006)	(.004)	(.004)	(.004)	(.004)
High Income	.010**	.006	.011**	.009**	.007**	.007**	.004	.003
	(.003)	(.003)	(.003)	(.003)	(.002)	(.002)	(.002)	(.002)
Parent Any College (0,1)								
Low Income	.069*	.076*	.044	.013	.060*	.042	.020	.020
	(.033)	(.035)	(.034)	(.033)	(.024)	(.024)	(.025)	(.024)
High Income	.025	.048**	.005	.002	-.003	-.002	.048**	.032**
	(.014)	(.015)	(.015)	(.015)	(.012)	(.012)	(.011)	(.011)
Family Structure								
Only Child (0,1)	-.078*	-.038	-.028	-.125**	-.015	-.042**	-.035**	-.027*
	(.033)	(.035)	(.031)	(.031)	(.015)	(.015)	(.013)	(.013)
First Born (0,1)	.004	.015	.002	-.004	.029**	.001	.017	.010
	(.015)	(.016)	(.016)	(.016)	(.011)	(.010)	(.010)	(.009)
Younger Siblings (#)	-.004	-.005	-.006	-.004	-.007**	-.002	-.006**	-.004
	(.004)	(.004)	(.004)	(.004)	(.003)	(.003)	(.002)	(.002)
Older Siblings (#)	-.018**	-.010	-.144**	-.127*	-.007*	-.012**	-.006	-.009**
	(.005)	(.006)	(.005)	(.005)	(.003)	(.003)	(.003)	(.003)
Employ. Rate, Local (ln)								
Low Income	-.047	-.059	.929	1.046*	-.489	-.467	-.598	.184
	(.476)	(.506)	(.492)	(.483)	(.467)	(.461)	(.493)	(.479)
High Income	-.131	-.095	.087	.300	-.268	.019	.236	.483
	(.213)	(.226)	(.217)	(.214)	(.279)	(.275)	(.266)	(.258)
Med. Fam. Inc., Regional (ln)	.123	.414*	.190	.465**	-.155	.276	-.105	.097
	(.162)	(.172)	(.178)	(.175)	(.146)	(.144)	(.139)	(.135)
Net Migration Rate, Reg. (proportion)	-.536	-.886**	-.481	-.630*	-.249	-.479	-.031	-.300
	(.290)	(.308)	(.301)	(.296)	(.267)	(.264)	(.243)	(.236)
Farm Pop. (proportion)	.179	.513	.521	.771*	-.340	.226	-.058	.006
	(.332)	(.353)	(.359)	(.353)	(.216)	(.214)	(.222)	(.216)
18-24 Yr-olds in Col. (proportion)	.799*	.933*	.928*	1.011**	.314	.746*	.311	.346
	(.407)	(.432)	(.366)	(.359)	(.336)	(.332)	(.273)	(.265)
Col/HS Earnings (ln)								
Low Income	1.393*	1.151	.606	.440	.310	.553	.472*	.243
	(.564)	(.599)	(.334)	(.328)	(.377)	(.373)	(.222)	(.216)
High Income	.987*	.892*	.537*	.434	.796**	1.303**	.447**	.432**
	(.423)	(.449)	(.230)	(.226)	(.299)	(.295)	(.151)	(.147)
South (0,1)	.070	.144*	.083	.143*	-.025	.106	-.018	.019
	(.061)	(.065)	(.065)	(.064)	(.056)	(.055)	(.051)	(.049)
Intercept	2.092	-.634	1.366	-1.031	4.98	.696	4.58	2.67
R^2	.135	.124	.091	.114	.084	.100	.090	.091
F	9.69	8.80	7.19	9.22	9.17	11.16	12.08	12.11
(d.f.)	(21, 1304)	(21, 1304)	(21, 1501)	(21, 1501)	(21, 2103)	(21, 2103)	(21, 2554)	(21, 2554)

* : significant at .05 level.

**: significant at .01 level

Standard errors in parentheses.

Table 3

MEAN ELASTICITIES -- PROBABILITY OF ATTENDING A FOUR-YEAR COLLEGE

	IDES (1974) Female		NLS (1972) Female		IDES (1974) Male		NLS (1972) Male	
	No Tests	Tests	No Tests	Tests	No Tests	Tests	No Tests	Tests
College Lifetime Earn.	16.3**	15.1**	8.9**	6.3*	5.8**	6.9**	2.8*	1.4
HS Lifetime Earn.	-13.3**	-11.6*	-8.8**	-6.7*	-2.4	-4.8*	-3.3**	-2.9*
4-Yr. Private Tuition	-.93*	-.84	-1.16**	-1.44**	-1.76**	-2.46**	-.87**	-1.41**
4-Yr. Public Tuition	.07	.32	.11	.19	.58**	.33	-.34**	-.34*
2-Yr. Public Tuition	.23	.23	.25*	.20	.20	.29	.43**	.47**
Parents' Income	.33**	.27**	.46**	.42**	.30**	.29**	.31**	.26**
# of Children	-.11	-.05	-.17**	-.19**	-.30**	-.34**	-.20**	-.22**
Father's Education	.93**	.84**	.77**	.65**	1.20**	.98**	1.05**	.90**
Mother's Education	.80**	.49	1.10**	.94**	.90**	.70*	.46*	.48*
Parent Any College	.15**	.11	.11*	.12*	.09	.09	.10*	.06
Employment Rate, Local	-4.5*	-4.34*	.16	.86	-.21	-1.47	2.77	1.81
Net Mig., Regional	-.31**	-.36**	-.08	-.07	-.13**	-.09	-.01	.02
18-24 Yr Olds in Col (Reg)	7.0**	8.32**	2.50*	2.12	4.17**	2.95*	.42	-.48
South	.78**	1.00**	.08	.04	.43*	.19	-.06	-.14
Reading Score		2.16**		1.58**		2.35**		1.23**
Math Score		1.76**		3.74**		2.61**		3.81**
Mean Sample Probability	.357		.382		.391		.430	

* : significant at .05 level

**: significant at .01 level

Estimated at population means from logit function estimates, Table A.

Table 4

EX POST PROBABILITIES OF COLLEGE ATTENDANCE FOR VARIOUS INITIAL PROBABILITIES AND SPECIFIED CHANGES IN EXOGENOUS VARIABLES

	IDES (1974) Female			NLS (1972) Female			IDES (1974) Male			NLS (1972) Male		
Initial Value:	p=.2	p=.5	p=.8	p=.2	p=.5	p=.8	p=.2	p=.5	p=.8	p=.2	p=.5	p=.8
College Lifetime Earn. (-1 std. dev.)	.04	.15	.40	.08	.27	.60	.13	.37	.70	.16	.43	.75
HS Lifetime Earn. (+1 std. dev.)	.06	.20	.50	.09	.28	.61	.17	.44	.76	.15	.41	.74
Parent's Income (-1 std. dev.)	.16	.43	.75	.14	.40	.73	.16	.43	.75	.16	.43	.75
Father's Ed (-1 std. dev.)	.15	.41	.74	.16	.43	.75	.13	.38	.71	.14	.40	.73
Mother's Ed (-1 std. dev.)	.17	.44	.76	.15	.42	.74	.16	.43	.75	.18	.46	.78
Parent Any College (from 1 to 0)	.13	.38	.71	.15	.42	.74	.16	.43	.75	.15	.42	.74
4-Yr. Private Tuition (+1 std. dev.)	.16	.44	.76	.17	.43	.75	.14	.39	.72	.16	.44	.76
Means and Std. Dev. of Excg. Variables:												
*College Lifetime Earn. (-1 std. dev.)	$107,779 (-7,589)			$109,974 (-7,562)			$186,063 (-10,747)			$187,400 (-10,485)		
*HS Lifetime Earn (+1 std. dev.)	$ 89,501 (+6,394)			$ 91,491 (+6,638)			$149,194 (+9,452)			$151,448 (+ 9,863)		
*Parent's Income (-1 std. dev.)	$ 15,033 (-6,675)			$ 10,777 (-4,679)			$ 15,141 (-6,499)			$ 11,324 (- 4,738)		
Father's Ed (-1 std. dev.)	12.5 yrs (-3.1)			12.8 yrs (-2.9)			12.4 yrs (-3.2)			12.8 yrs (-2.9)		
Mother's Ed (-1 std. dev.)	12.3 yrs (-2.3)			12.4 yrs (-2.4)			12.3 yrs (-2.3)			12.5 yrs (-2.3)		
Parent Any College (mean only)	.48			.52			.47			.52		
*4-Yr. Private Tuition (+1 std. dev.)	$ 1,739 (+333)			$ 1,787 (+315)			$ 1,764 (+301)			$ 1,771 (+316)		

*denotes evaluation of log distribution at its mean and at its mean minus or plus one standard deviation.

Derived from estimated logit functions excluding test scores.

Table A

LOG-ODDS OF ATTENDING A FOUR-YEAR COLLEGE: LOGIT FUNCTION ESTIMATES

	IDES (1974) Female		NLS (1972) Female		IDES (1974) Male		NLS (1972) Male	
	No Tests	Tests	No Tests	Tests	No Tests	Tests	No Tests	Tests
Parents' Income (ln)	.501**	.388**	.716**	.623**	.467**	.430**	.537**	.423**
	(.122)	(.129)	(.107)	(.116)	(.117)	(.131)	(.099)	(.110)
# of Children (ln)	-.162	-.078	-.258**	-.275**	-.475**	-.513**	-.346**	-.358**
	(.147)	(.157)	(.095)	(.105)	(.135)	(.152)	(.085)	(.094)
Father's Education (yrs)	.111**	.097**	.094**	.076**	.153**	.118**	.141**	.115**
	(.030)	(.031)	(.025)	(.027)	(.027)	(.030)	(.023)	(.026)
Mother's Education (yrs)	.097**	.058	.139**	.113**	.116**	.085*	.063*	.063*
	(.037)	(.039)	(.026)	(.029)	(.036)	(.040)	(.025)	(.028)
Parent Any College (0,1)	.477**	.327	.333*	.328*	.300	.279	.339*	.190
	(.178)	(.188)	(.153)	(.166)	(.164)	(.181)	(.140)	(.155)
2-Yr Pub. Tuition (ln)	.346	.335	.384*	.297	.323	.440	.746**	.770**
	(.253)	(.271)	(.158)	(.174)	(.215)	(.240)	(.140)	(.154)
4-Yr Pub. Tuition (ln)	.108	.455	.179	.283	.922**	.487	-.576**	-.551*
	(.464)	(.494)	(.229)	(.252)	(.347)	(.390)	(.216)	(.238)
4-Yr Private Tuition (ln)	-1.39*	-1.206	-1.807**	-2.126**	-2.783**	-3.670**	-1.484**	-2.299**
	(.652)	(.706)	(.502)	(.557)	(.745)	(.834)	(.472)	(.530)
Employ. Rate, Local (ln)	-6.67*	-6.262*	.251	1.273	-.331	-2.190	4.754	2.943
	(2.61)	(2.753)	(3.747)	(4.114)	(2.435)	(2.705)	(3.752)	(4.162)
Net Migration Rate, Reg. (Proportion)	-22.77**	-25.638**	-6.132	-5.224	-12.201**	-8.071	-1.006	1.728
	(6.00)	(6.435)	(4.175)	(4.613)	(4.209)	(4.746)	(3.115)	(3.494)
18-24 Yr Olds in Col. (Proportion)	30.07**	34.501**	10.773*	8.679	19.253**	12.833*	1.993	-2.171
	(8.17)	(8.713)	(4.780)	(5.236)	(5.720)	(6.397)	(3.755)	(4.218)
South (0,1)	2.74**	3.412**	.475	.235	1.667*	.692	-.364	-.839
	(1.05)	(1.125)	(.574)	(.629)	(.814)	(.911)	(.517)	(.584)
Col. Lifetime Earn. (ln)	24.42**	21.787**	13.930**	9.372*	9.155**	10.328**	4.757*	2.324
	(5.76)	(6.120)	(4.114)	(4.503)	(2.246)	(2.517)	(1.944)	(2.151)
HS Lifetime Earn. (ln)	-19.96**	-16.749*	-13.694**	-9.915*	-3.749	-7.172	-5.702**	-4.656*
	(6.96)	(7.394)	(4.350)	(4.758)	(2.977)	(3.304)	(2.104)	(2.331)
Reading Score		-.059**		.043**		.068**		.037**
		(.011)		(.008)		(.010)		(.007)
Math Score		.049**		.103**		.073**		.111**
		(.010)		(.009)		(.010)		(.008)
Intercept	-65.18	-80.992	-5.599	.237	-66.982	-34.929	15.0998	32.095
R^2	.171	.262	.175	.313	.182	.334	.157	.306
Neg. Log-Likelihood Function	749.9	679.3	1218.7	1046.3	872.1	732.1	1448	1202.0
No. of Observations	1326	1326	2124	2124	1523	1523	2351	2351
χ^2 of Estimate (χ^2 degrees of freedom)	227.9 (14)	369.2 (16)	388.2 (14)	733.1 (16)	293.8 (14)	573.8 (16)	382.9 (14)	808.5 (16)

* : significant at .05 level.

**: significant at .01 level.

Standard errors in parentheses.